Carbapenem-Resistant Enterobacteriaceae in Kentucky – Initial Six Months of Mechanism Testing

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ABSTRACT

BACKGROUND: A global rise in carbapenem-resistant Enterobacteriaceae (CRE) has been noted over the past two decades. State and local data on CRE are necessary to better inform public health interventions.

METHODS: Reporting of CRE (i.e., Enterobacteriaceae resistant to any carbapenem or shown to produce a carbapenemase) was mandated in Kentucky in 2015. Voluntary submission of isolates to the Antibiotic Resistance Laboratory Network regional laboratory for carbapenemase testing began September 2017. Demographic data collected as part of reporting included age, sex, county of residence, and inpatient/outpatient status. Descriptive and chi-square analyses were performed.

RESULTS: Between 9/1/2017 and 2/28/2018, 149 CRE were reported to the Kentucky Department for Public Health. Testing for presence of a carbapenemase was performed on 115 isolates (77.2%); 44 (38.3%) were carbapenemase producing (CP)-CRE and *Klebsiella pneumoniae* carbapenemase (KPC) was identified from 38 (86.4%). Also identified were Verona integron-encoded metallo-β-lactamase (VIM; 5, 11.4%) and New Delhi metallo-β-lactamase (NDM; 1, 2.3%). Identification of carbapenemase varied among genera: *Citrobacter* (3/4, 75%), *Klebsiella* (21/40, 52.5%), *Serratia* (2/5, 40%), *Escherichia* (6/20, 30%), *Enterobacter* (11/41, 26.8%), *Proteus* (0/4, 0%), other genera (1/2, 50%). CRE isolates from urban or suburban areas were more likely CP-CRE than were those from rural areas (30/65, 46.2% versus 14/50, 28%, p = 0.047). Carbapenemase was identified more often among CRE isolates from currently hospitalized patients than from patients whose cultures were collected outside of an acute care hospital (37/70, 52.8% versus 7/45, 15.6%, p < 0.001).

CONCLUSION: The percentage of CRE that were CP-CRE in Kentucky was comparable to that reported for the United States (38 versus 32%). *Klebsiella* spp., the genera historically associated with CR-CRE, made up less than half of CP-CRE. CP isolates were identified from urban, suburban, and rural settings and more frequently from isolates collected in hospitals compared to the community. The additional epidemiology obtained as part of this reporting system has identified metropolitan areas of the state as targets for CRE prevention efforts.

Introduction

- Carbapenem resistance in the United States was first described in 2001
- Subsequent spread was relatively rapid
- *Klebsiella pneumoniae* carbapenemase (KPC) has now been seen in all 50 states
- Additional mechanisms of carbapenem resistance have been seen and have more regional, than national, distribution
- CDC CRE-specific guidance produced in 2009 and updated in 2013 and 2015
- Voluntary reporting of CRE requested in Kentucky in 2013
- Legislatively mandated reporting began in Kentucky in 2015
- Submission of isolates for testing beyond local lab ASTs infrequent until late 2017
- Voluntary submission of all CRE formally requested by Kentucky Department for Public Health and the Division of Laboratory Services in 2017

Methods

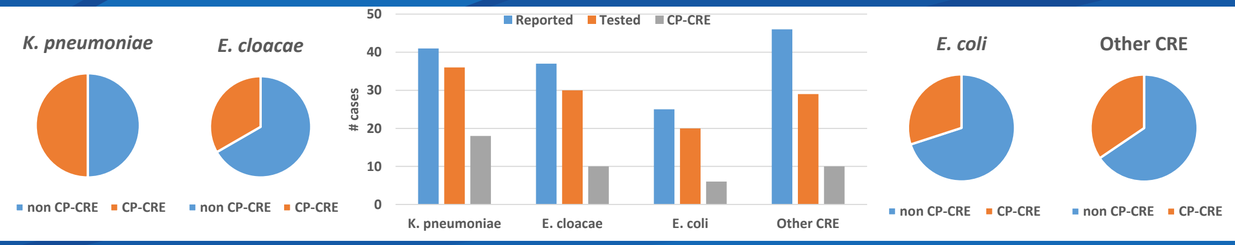
- CRE isolates submitted to the state laboratory were tested at the Antibiotic Resistance Laboratory Network regional laboratory in Madison, Wisconsin
- Testing included verification of organism ID, antibiotic susceptibility testing (AST), phenotypic test for carbapenemase production – modified carbapenem inactivation method (mCIM), and molecular testing for mechanism of carbapenem resistance – Cepheid Xpert® Carba-R
- Patient demographic and basic clinical details provided by completion of standard multidrug resistant organism reporting form (Kentucky EPID 250)
- Descriptive analyses performed for CRE isolates submitted from September 1, 2017 through February 28, 2018

Results

- During 6 month period, 149 CRE were reported to KDPH
- 115 isolates (77.2%) were submitted to the state laboratory for testing
- 44 isolates (38.3%) were carbapenemase-producing CRE (CP-CRE)
- 38 of 44 (86.4%) were *Klebsiella pneumoniae* carbapenemase (KPC)
- 5 of 44 (11.4%) were Verona integron-encoded metallo-β-lactamase (VIM)
- 1 of 44 (2.3%) was New Delhi metallo-β-lactamase (NDM)
- VIM has been reported more often in Kentucky than in any other state
- Carbapenemase production varied among genera
- Citrobacter species most likely to be CP (3/4, 75.0%)
- CP-CRE more common from urban/suburban facilities than from rural facilities; facilities were primarily short-stay acute-care
- Carbapenemase production more common in hospitalized patients

Conclusions

- CP-CRE percentage slightly higher than that recently reported for the US (38.3 vs 31.5%)
- Non-KPC CP-CRE percentage was similar to that noted for the US (13.6% vs 15.5%)
- Less than 50% of CP-CRE identified were *Klebsiella pneumoniae*
- 4 of 5 VIM were identified in *Enterobacter* species
- Given the more common occurrence of CP-CRE in non-rural facilities and in patients hospitalized in acute care settings, more targeted surveillance, prevention, and response activities can be focused on these facilities



SUMMARY

- Carbapenemase-producing CRE have become widely distributed across the United States
- KPC is relatively common in Kentucky
- VIM has been seen more frequently in Kentucky than in any other state
- There were no reports of IMP or OXA-48 in Kentucky between 2013 and 2017
- A focus on testing only the "big 3" CRE (i.e., *Klebsiella pneumoniae, Enterobacter cloacae, Escherichia coli*) would have resulted in missed identification of 10 of 44 (22.7%) CP-CRE
- 10 of 29 (34.5%) submitted non-big 3 CRE were CP-CRE
- Understanding the local epidemiology of CP-CRE can be useful in developing more targeted strategies for prevention and containment

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